Tech. Bul. # 20 - Supp.

OREGON STATE
HIGHWAY DEPARTMENT
TRAFFIC ENGINEERING DIV.
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Technical Bulletin No. 20 Supplement
State Highway Spiral Supplementary Tables

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TECHNICAL BULLETIN NO. 20, SUPPLEMENT

OREGON STATE HIGHWAY DEPARTMENT

R. H. BALDOCK, STATE HIGHWAY ENGINEER

STATE HIGHWAY SPIRAL
SUPPLEMENTARY TABLES

By

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Urban Location Engineer

Revised With Assistance of
John C. Bandy and John R. Oakes

Published By

OREGON STATE HIGHWAY COMMISSION

Ben R. Chandler, Chairman
Chas. H. Reynolds, Commissioner
M. K. McIver, Commissioner

These supplementary spiral tables are being published as an aid to the engineer to be used in spiraling curves where conditions do not permit the use of the standards given on page nine of Technical Bulletin No. 20. Whenever possible the standards will apply.

The spiral values and radii are given to three decimal places as an aid in the computation of curves. Do not show these values to more than two decimal places on maps and profiles.

ERRATA

FROM TECHNICAL BULLETIN NO. 20

Technical Bulletin No. 20 should be corrected for published errors as follows:

Page 6 $S = \frac{D^2}{2^a}$ not $S = \frac{D2}{100^a}$

Page 7 In the formula for "p" and "q" the numerator of the fraction should be 28.647889757 not 28.64788957.

Page 12 The radius and chord lengths for a 2.80° curve were left out. Should be 2,046.28 - 00.840 - 0°21.000 - 00°42.00 - 25.00 - 50.00 - 99.99.

Page 35 "i" for 9.78 station should be 950.746 not 850.746.

Page 51 "$\frac{V}{L}$" for 5.7° should be .333648 not .336648.

Page 72 "V" for 400' should be 133.35' not 133.25'.

Page 80 "C" for 500' should be 499.32' not 498.32'.

Page 126 "$\triangle 6 = \triangle 5 - (S_1 + \triangle$ for D_1 for ½ length of intermediate spiral)." The use here of ½ length of intermediate spiral is a close approximation of the true answer.

D. C.	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000
0°30'	1.0000	0.5000	0.3333	0.2500	0.2000	0.1667	0.1429	0.1250	0.1111	0.1000	0.0909	0.0833	0.0769	0.0714	0.0667	0.0625	0.0588	0.0556	0.0526	0.0500
1°00'	2.0000	1.0000	0.6667	0.5000	0.4000	0.3333	0.2857	0.2500	0.2222	0.2000	0.1818	0.1667	0.1538	0.1429	0.1333	0.1250	0.1176	0.1111	0.1053	0.1000
1°30'	3.0000	1.5000	1.0000	0.7500	0.6000	0.5000	0.4286	0.3750	0.3333	0.3000	0.2727	0.2500	0.2308	0.2143	0.2000	0.1875	0.1765	0.1667	0.1579	0.1500
2°00'	4.0000	2.0000	1.3333	1.0000	0.8000	0.6667	0.5714	0.5000	0.4444	0.4000	0.3636	0.3333	0.3077	0.2857	0.2667	0.2500	0.2353	0.2222	0.2105	0.2000
2°30'	5.0000	2.5000	1.6667	1.2500	1.0000	0.8333	0.7143	0.6250	0.5556	0.5000	0.4545	0.4167	0.3846	0.3571	0.3333	0.3125	0.2941	0.2778	0.2632	0.2500
3°00'	6.0000	3.0000	2.0000	1.5000	1.2000	1.0000	0.8571	0.7500	0.6667	0.6000	0.5455	0.5000	0.4615	0.4286	0.4000	0.3750	0.3529	0.3333	0.3158	0.3000
3°30'	7.0000	3.5000	2.3333	1.7500	1.4000	1.1667	1.0000	0.8750	0.7778	0.7000	0.6364	0.5833	0.5385	0.5000	0.4667	0.4375	0.4118	0.3889	0.3684	0.3500
4°00'	8.0000	4.0000	2.6667	2.0000	1.6000	1.3333	1.1429	1.0000	0.8889	0.8000	0.7273	0.6667	0.6154	0.5714	0.5333	0.5000	0.4706	0.4444	0.4211	0.4000
4°30'	9.0000	4.5000	3.0000	2.2500	1.8000	1.5000	1.2857	1.1250	1.0000	0.9000	0.8182	0.7500	0.6923	0.6429	0.6000	0.5625	0.5294	0.5000	0.4737	0.4500
5°00'	10.0000	5.0000	3.3333	2.5000	2.0000	1.6667	1.4286	1.2500	1.1111	1.0000	0.9091	0.8333	0.7692	0.7143	0.6667	0.6250	0.5882	0.5556	0.5263	0.5000
5°30'	11.0000	5.5000	3.6667	2.7500	2.2000	1.8333	1.5714	1.3750	1.2222	1.1000	1.0000	0.9167	0.8462	0.7857	0.7333	0.6875	0.6471	0.6111	0.5789	0.5500
6°00'	12.0000	6.0000	4.0000	3.0000	2.4000	2.0000	1.7143	1.5000	1.3333	1.2000	1.0909	1.0000	0.9231	0.8571	0.8000	0.7500	0.7059	0.6667	0.6316	0.6000
6°30'	13.0000	6.5000	4.3333	3.2500	2.6000	2.1667	1.8571	1.6250	1.4444	1.3000	1.1818	1.0833	1.0000	0.9286	0.8667	0.8125	0.7647	0.7222	0.6842	0.6500
7°00'	14.0000	7.0000	4.6667	3.5000	2.8000	2.3333	2.0000	1.7500	1.5556	1.4000	1.2727	1.1667	1.0769	1.0000	0.9333	0.8750	0.8235	0.7778	0.7368	0.7000
7°30'	15.0000	7.5000	5.0000	3.7500	3.0000	2.5000	2.1429	1.8750	1.6667	1.5000	1.3636	1.2500	1.1538	1.0714	1.0000	0.9375	0.8824	0.8333	0.7895	0.7500
8°00'	16.0000	8.0000	5.3333	4.0000	3.2000	2.6667	2.2857	2.0000	1.7778	1.6000	1.4545	1.3333	1.2308	1.1429	1.0667	1.0000	0.9412	0.8889	0.8421	0.8000
8°30'	17.0000	8.5000	5.6667	4.2500	3.4000	2.8333	2.4286	2.1250	1.8889	1.7000	1.5455	1.4167	1.3077	1.2143	1.1333	1.0625	1.0000	0.9444	0.8947	0.8500
9°00'	18.0000	9.0000	6.0000	4.5000	3.6000	3.0000	2.5714	2.2500	2.0000	1.8000	1.6364	1.5000	1.3846	1.2857	1.2000	1.1250	1.0588	1.0000	0.9474	0.9000
9°30'	19.0000	9.5000	6.3333	4.7500	3.8000	3.1667	2.7143	2.3750	2.1111	1.9000	1.7273	1.5833	1.4615	1.3571	1.2667	1.1875	1.1176	1.0556	1.0000	0.9500
10°00'	20.0000	10.0000	6.6667	5.0000	4.0000	3.3333	2.8571	2.5000	2.2222	2.0000	1.8182	1.6667	1.5385	1.4286	1.3333	1.2500	1.1765	1.1111	1.0526	1.0000

D. C.	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000
0°30'	0.125°	0.250°	0.375°	0.500°	0.625°	0.750°	0.875°	1.000°	1.125°	1.250°	1.375°	1.500°	1.625°	1.750°	1.875°	2.000°	2.125°	2.250°	2.375°	2.500°
1°00'	0.250°	0.500°	0.750°	1.000°	1.250°	1.500°	1.750°	2.000°	2.250°	2.500°	2.750°	3.000°	3.250°	3.500°	3.750°	4.000°	4.250°	4.500°	4.750°	5.000°
1°30'	0.375°	0.750°	1.125°	1.500°	1.875°	2.250°	2.625°	3.000°	3.375°	3.750°	4.125°	4.500°	4.875°	5.250°	5.625°	6.000°	6.375°	6.750°	7.125°	7.500°
2°00'	0.500°	1.000°	1.500°	2.000°	2.500°	3.000°	3.500°	4.000°	4.500°	5.000°	5.500°	6.000°	6.500°	7.000°	7.500°	8.000°	8.500°	9.000°	9.500°	10.000°
2°30'	0.625°	1.250°	1.875°	2.500°	3.125°	3.750°	4.375°	5.000°	5.625°	6.250°	6.875°	7.500°	8.125°	8.750°	9.375°	10.000°	10.625°	11.250°	11.875°	12.500°
3°00'	0.750°	1.500°	2.250°	3.000°	3.750°	4.500°	5.250°	6.000°	6.750°	7.500°	8.250°	9.000°	9.750°	10.500°	11.250°	12.000°	12.750°	13.500°	14.250°	15.000°
3°30'	0.875°	1.750°	2.625°	3.500°	4.375°	5.250°	6.125°	7.000°	7.875°	8.750°	9.625°	10.500°	11.375°	12.250°	13.125°	14.000°	14.875°	15.750°	16.625°	17.500°
4°00'	1.000°	2.000°	3.000°	4.000°	5.000°	6.000°	7.000°	8.000°	9.000°	10.000°	11.000°	12.000°	13.000°	14.000°	15.000°	16.000°	17.000°	18.000°	19.000°	20.000°
4°30'	1.125°	2.250°	3.375°	4.500°	5.625°	6.750°	7.875°	9.000°	10.125°	11.250°	12.375°	13.500°	14.625°	15.750°	16.875°	18.000°	19.125°	20.250°	21.375°	22.500°
5°00'	1.250°	2.500°	3.750°	5.000°	6.250°	7.500°	8.750°	10.000°	11.250°	12.500°	13.750°	15.000°	16.250°	17.500°	18.750°	20.000°	21.250°	22.500°	23.750°	25.000°
5°30'	1.375°	2.750°	4.125°	5.500°	6.875°	8.250°	9.625°	11.000°	12.375°	13.750°	15.125°	16.500°	17.875°	19.250°	20.625°	22.000°	23.375°	24.750°	26.125°	27.500°
6°00'	1.500°	3.000°	4.500°	6.000°	7.500°	9.000°	10.500°	12.000°	13.500°	15.000°	16.500°	18.000°	19.500°	21.000°	22.500°	24.000°	25.500°	27.000°	28.500°	30.000°
6°30'	1.625°	3.250°	4.875°	6.500°	8.125°	9.750°	11.375°	13.000°	14.625°	16.250°	17.875°	19.500°	21.125°	22.750°	24.375°	26.000°	27.625°	29.250°	30.875°	32.500°
7°00'	1.750°	3.500°	5.250°	7.000°	8.750°	10.500°	12.250°	14.000°	15.750°	17.500°	19.250°	21.000°	22.750°	24.500°	26.250°	28.000°	29.750°	31.500°	33.250°	35.000°
7°30'	1.875°	3.750°	5.625°	7.500°	9.375°	11.250°	13.125°	15.000°	16.875°	18.750°	20.625°	22.500°	24.375°	26.250°	28.125°	30.000°	31.875°	33.750°	35.625°	37.500°
8°00'	2.000°	4.000°	6.000°	8.000°	10.000°	12.000°	14.000°	16.000°	18.000°	20.000°	22.000°	24.000°	26.000°	28.000°	30.000°	32.000°	34.000°	36.000°	38.000°	40.000°
8°30'	2.125°	4.250°	6.375°	8.500°	10.625°	12.750°	14.875°	17.000°	19.125°	21.250°	23.375°	25.500°	27.625°	29.750°	31.875°	34.000°	36.125°	38.250°	40.375°	42.500°
9°00'	2.250°	4.500°	6.750°	9.000°	11.250°	13.500°	15.750°	18.000°	20.250°	22.500°	24.750°	27.000°	29.250°	31.500°	33.750°	36.000°	38.250°	40.500°	42.750°	45.000°
9°30'	2.375°	4.750°	7.125°	9.500°	11.875°	14.250°	16.625°	19.000°	21.375°	23.750°	26.125°	28.500°	30.875°	33.250°	35.625°	38.000°	40.375°	42.750°	45.125°	47.500°
10°00'	2.500°	5.000°	7.500°	10.000°	12.500°	15.000°	17.500°	20.000°	22.500°	25.000°	27.500°	30.000°	32.500°	35.000°	37.500°	40.000°	42.500°	45.000°	47.500°	50.000°

D. C.	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950
0°30'	0.036	0.145+	0.327	0.582	0.909	1.309	1.782	2.327	2.945+	3.636	4.400	5.236	6.145-	7.126	8.181	9.308	10.507	11.780	13.125-
1°00'	0.073	0.291	0.654	1.164	1.818	2.618	3.563	4.654	5.890	7.271	8.798	10.470	12.287	14.250	16.357	18.610	21.008	23.552	26.240
1°30'	0.109	0.436	0.982	1.745+	2.727	3.927	5.344	6.980	8.834	10.905-	13.194	15.701	18.426	21.367	24.527	27.903	31.497	35.308	39.336
2°00'	0.145+	0.582	1.309	2.327	3.636	5.235-	7.125-	9.305+	11.776	14.537	17.587	20.928	24.557	28.477	32.685-	37.182	41.967	47.041	52.402
2°30'	0.182	0.727	1.636	2.908	4.544	6.543	8.905-	11.629	14.716	18.165+	21.976	26.148	30.681	35.574	40.828	46.441	52.413	58.743	65.431
3°00'	0.218	0.873	1.963	3.490	5.452	7.851	10.684	13.952	17.654	21.790	26.359	31.361	36.794	42.658	48.952	55.676	62.827	70.406	78.411
3°30'	0.255-	1.018	2.290	4.071	6.361	9.157	12.462	16.272	20.589	25.410	30.736	36.564	42.894	49.725-	57.054	64.882	73.205-	82.023	91.333
4°00'	0.290	1.163	2.617	4.653	7.268	10.464	14.238	18.591	23.520	29.026	35.105-	41.757	48.980	56.771	65.130	74.054	83.540	93.585+	104.189
4°30'	0.327	1.309	2.945-	5.234	8.176	11.769	16.014	20.907	26.448	32.635-	39.465+	46.937	55.048	63.795+	73.176	83.187	93.825+	105.086	116.968
5°00'	0.364	1.454	3.271	5.815-	9.083	13.074	17.787	23.220	29.371	36.238	43.816	52.104	61.098	70.794	81.189	92.277	104.055-	116.518	129.661
5°30'	0.400	1.600	3.598	6.395+	9.989	14.378	19.559	25.531	32.290	39.833	48.156	57.256	67.127	77.765-	89.164	101.319	114.225-	127.874	142.260
6°00'	0.436	1.745-	3.925+	6.976	10.895-	15.680	21.329	27.838	35.203	43.420	52.484	62.390	73.132	84.704	97.099	110.309	124.327	139.145+	154.754
6°30'	0.473	1.890	4.252	7.556	11.800	16.982	23.097	30.141	38.110	46.998	56.799	67.507	79.113	91.610	104.989	119.241	134.357	150.325+	167.135+
7°00'	0.509	2.036	4.579	8.136	12.705+	18.282	24.862	32.441	41.011	50.567	61.101	72.603	85.066	98.479	112.831	128.112	144.308	161.407	179.395+
7°30'	0.545+	2.181	4.905+	8.716	13.609	19.581	26.625+	34.736	43.906	54.126	65.387	77.679	90.990	105.309	120.622	136.916	154.175-	172.383	191.524
8°00'	0.582	2.326	5.232	9.295+	14.513	20.878	28.386	37.027	46.793	57.673	69.657	82.732	96.884	112.098	128.359	145.649	163.951	183.247	203.514
8°30'	0.618	2.472	5.558	9.875-	15.416	22.174	30.143	39.313	49.672	61.209	73.910	87.760	102.743	118.842	136.036	154.307	173.633	193.991	215.357
9°00'	0.654	2.617	5.885-	10.454	16.317	23.469	31.898	41.594	52.543	64.732	78.145+	92.763	108.568	125.539	143.652	162.886	183.213	204.609	227.043
9°30'	0.691	2.762	6.211	11.032	17.219	24.761	33.649	43.869	55.406	68.243	82.361	97.739	114.356	132.186	151.203	171.380	192.688	215.094	238.566
10°00'	0.727	2.907	6.537	11.610	18.119	26.052	35.397	46.139	58.259	71.739	86.556	102.687	120.104	138.781	158.686	179.787	202.050	225.439	249.917

D. C.	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000
0°30'	50.000	100.000	149.999	199.998	249.997	299.995-	349.992	399.988	449.983	499.976	549.968	599.959	649.948	699.935-	749.920	799.903	849.883	899.861	949.837	999.810
1°00'	50.000	99.999	149.997	199.994	249.988	299.979	349.967	399.951	449.931	499.905-	549.873	599.836	649.791	699.739	749.679	799.610	849.532	899.445-	949.347	999.239
1°30'	50.000	99.998	149.994	199.986	249.973	299.954	349.927	399.890	449.844	499.786	549.715-	599.630	649.530	699.413	749.277	799.123	848.948	898.752	948.532	998.288
2°00'	50.000	99.997	149.990	199.976	249.952	299.918	349.869	399.805+	449.722	499.619	549.493	599.342	649.164	698.956	748.716	798.442	848.131	897.782	947.392	996.958
2°30'	49.999	99.995+	149.984	199.962	249.926	299.872	349.796	399.695+	449.566	499.405+	549.209	598.973	648.694	698.369	747.995-	797.566	847.082	896.536	945.927	995.251
3°00'	49.999	99.993	149.977	199.945+	249.893	299.815-	349.706	399.562	449.376	499.144	548.861	598.521	648.120	697.653	747.114	796.498	845.800	895.016	944.140	993.168
3°30'	49.999	99.991	149.969	199.925+	249.854	299.748	349.600	399.403	449.151	498.835+	548.450	597.988	647.443	696.807	746.074	795.237	844.289	893.223	942.033	990.711
4°00'	49.998	99.988	149.959	199.903	249.810	299.671	349.478	399.221	448.891	498.479	547.976	597.373	646.662	695.832	744.876	793.784	842.548	891.158	939.606	987.884
4°30'	49.998	99.985-	149.948	199.877	249.759	299.584	349.339	399.014	448.597	498.076	547.440	596.678	645.778	694.729	743.520	792.140	840.578	888.823	936.863	984.688
5°00'	49.998	99.981	149.936	199.848	249.703	299.486	349.185-	398.783	448.268	497.625+	546.841	595.901	644.791	693.498	742.008	790.307	838.382	886.220	933.806	981.128
5°30'	49.997	99.977	149.922	199.816	249.640	299.379	349.014	398.528	447.905+	497.128	546.180	595.043	643.702	692.140	740.339	788.285+	835.961	883.351	930.438	977.208
6°00'	49.997	99.973	149.907	199.781	249.572	299.261	348.826	398.249	447.508	496.584	545.456	594.105+	642.511	690.655-	738.516	786.077	833.317	880.218	926.762	972.930
6°30'	49.996	99.968	149.891	199.743	249.498	299.132	348.623	397.946	447.077	495.993	544.671	593.087	641.219	689.044	736.539	783.683	830.452	876.826	922.782	968.301
7°00'	49.995+	99.963	149.874	199.702	249.418	298.994	348.403	397.618	446.611	495.356	543.824	591.990	639.827	687.309	734.410	781.104	827.368	873.175-	918.501	963.324
7°30'	49.995-	99.957	149.855+	199.658	249.332	298.845+	348.168	397.267	446.112	494.672	542.916	590.813	638.334	685.449	732.129	778.344	824.067	869.270	913.924	958.004
8°00'	49.994	99.951	149.836	199.610	249.240	298.687	347.916	396.892	445.579	493.942	541.946	589.558	636.742	683.466	729.698	775.404	820.552	865.113	909.055-	952.349
8°30'	49.993	99.945-	149.814	199.560	249.142	298.518	347.648	396.493	445.012	493.166	540.916	588.224	635.051	681.362	727.118	772.285-	816.826	860.708	903.898	946.362
9°00'	49.992	99.938	149.792	199.507	249.038	298.339	347.364	396.070	444.411	492.344	539.825+	586.812	633.263	679.136	724.391	768.989	812.891	856.060	898.458	940.052
9°30'	49.991	99.931	149.768	199.451	248.928	298.150	347.065-	395.624	443.777	491.477	538.675-	585.324	631.377	676.791	721.519	765.520	808.751	851.171	892.741	933.423
10°00'	49.990	99.924	149.743	199.392	248.813	297.950	346.749	395.154	443.110	490.564	537.464	583.758	629.395+	674.326	718.503	761.879	804.408	846.047	886.752	926.484

D. C.	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000
0°30'	0.009	0.036	0.082	0.145+	0.227	0.327	0.445+	0.582	0.736	0.909	1.100	1.309	1.536	1.782	2.045+	2.327	2.627	2.945+	3.281	3.636
1°00'	0.018	0.073	0.164	0.291	0.455-	0.654	0.891	1.164	1.473	1.818	2.200	2.618	3.072	3.563	4.090	4.653	5.253	5.889	6.562	7.270
1°30'	0.027	0.109	0.245+	0.436	0.682	0.982	1.336	1.745+	2.209	2.727	3.299	3.926	4.608	5.343	6.134	6.979	7.878	8.831	9.839	10.902
2°00'	0.036	0.145+	0.327	0.582	0.909	1.309	1.781	2.327	2.945-	3.635+	4.398	5.234	6.142	7.123	8.176	9.302	10.500	11.771	13.113	14.529
2°30'	0.045+	0.182	0.409	0.727	1.136	1.636	2.227	2.908	3.680	4.543	5.497	6.541	7.676	8.901	10.217	11.623	13.119	14.706	16.383	18.150
3°00'	0.055-	0.218	0.491	0.873	1.363	1.963	2.672	3.489	4.416	5.451	6.595-	7.847	9.208	10.677	12.255-	13.941	15.735-	17.636	19.646	21.763
3°30'	0.064	0.255-	0.573	1.018	1.590	2.290	3.117	4.070	5.151	6.358	7.692	9.152	10.739	12.451	14.290	16.255+	18.345+	20.561	22.902	25.368
4°00'	0.073	0.291	0.654	1.163	1.818	2.617	3.561	4.651	5.885+	7.264	8.788	10.456	12.267	14.223	16.322	18.565+	20.951	23.479	26.150	28.963
4°30'	0.082	0.327	0.736	1.309	2.045-	2.944	4.006	5.231	6.619	8.170	9.883	11.758	13.794	15.992	18.351	20.870	23.550	26.389	29.388	32.545+
5°00'	0.091	0.364	0.818	1.454	2.272	3.270	4.451	5.811	7.353	9.075-	10.977	13.058	15.318	17.758	20.375+	23.170	26.142	29.291	32.615+	36.115-
5°30'	0.100	0.400	0.900	1.599	2.499	3.597	4.895-	6.391	8.086	9.979	12.069	14.356	16.840	19.520	22.395-	25.464	28.727	32.183	35.831	39.670
6°00'	0.109	0.436	0.982	1.745-	2.725+	3.924	5.339	6.970	8.818	10.882	13.160	15.653	18.359	21.278	24.409	27.751	31.303	35.064	39.033	43.209
6°30'	0.118	0.473	1.063	1.890	2.952	4.250	5.782	7.549	9.550	11.783	14.249	16.947	19.875-	23.032	26.418	30.031	33.870	37.934	42.221	46.730
7°00'	0.127	0.509	1.145+	2.035+	3.179	4.576	6.226	8.128	10.281	12.684	15.337	18.238	21.387	24.781	28.421	32.303	36.427	40.791	45.394	50.232
7°30'	0.136	0.545+	1.227	2.180	3.406	4.902	6.669	8.705+	11.011	13.583	16.423	19.527	22.895+	26.526	30.417	34.567	38.974	43.635+	48.550	53.715-
8°00'	0.145+	0.582	1.308	2.325+	3.632	5.228	7.112	9.283	11.740	14.481	17.506	20.813	24.400	28.265+	32.406	36.822	41.509	46.465+	51.688	57.175+
8°30'	0.155-	0.618	1.390	2.471	3.859	5.553	7.554	9.859	12.468	15.378	18.588	22.096	25.901	29.999	34.388	39.067	44.032	49.280	54.808	60.613
9°00'	0.164	0.654	1.472	2.616	4.085-	5.879	7.996	10.435+	13.195-	16.273	19.667	23.376	27.397	31.726	36.363	41.302	46.542	52.078	57.908	64.027
9°30'	0.173	0.691	1.554	2.761	4.311	6.204	8.438	11.010	13.921	17.166	20.744	24.652	28.888	33.448	38.329	43.527	49.039	54.860	60.987	67.415-
10°00'	0.182	0.727	1.635+	2.906	4.537	6.529	8.879	11.585+	14.645+	18.057	21.818	25.925+	30.374	35.163	40.286	45.740	51.521	57.624	64.044	70.776

D. C.	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000
0°30'	25.000	50.000	75.000	100.000	125.000	149.999	174.999	199.998	224.997	249.996	274.995-	299.993	324.991	349.989	374.987	399.984	424.980	449.977	474.973	499.968
1°00'	25.000	50.000	75.000	99.999	124.998	149.997	174.995-	199.992	224.988	249.984	274.979	299.973	324.965+	349.956	374.946	399.935+	424.922	449.907	474.891	499.873
1°30'	25.000	50.000	74.999	99.998	124.996	149.992	174.988	199.982	224.974	249.964	274.953	299.938	324.922	349.902	374.880	399.854	424.825-	449.792	474.755+	499.715-
2°00'	25.000	49.999	74.998	99.996	124.992	149.986	174.978	199.968	224.954	249.937	274.916	299.890	324.861	349.826	374.786	399.740	424.688	449.630	474.565-	499.493
2°30'	25.000	49.999	74.997	99.994	124.988	149.979	174.966	199.949	224.928	249.901	274.868	299.829	324.782	349.728	374.666	399.594	424.513	449.422	474.321	499.208
3°00'	25.000	49.999	74.996	99.991	124.982	149.969	174.951	199.927	224.896	249.857	274.810	299.753	324.687	349.609	374.519	399.416	424.299	449.169	474.022	498.860
3°30'	25.000	49.998	74.995-	99.988	124.976	149.958	174.933	199.901	224.858	249.806	274.742	299.664	324.573	349.467	374.345+	399.205-	424.047	448.869	473.670	498.449
4°00'	25.000	49.998	74.993	99.984	124.968	149.945+	174.913	199.870	224.815+	249.746	274.662	299.562	324.443	349.305-	374.145-	398.962	423.756	448.524	473.264	497.976
4°30'	25.000	49.997	74.991	99.979	124.960	149.931	174.890	199.836	224.766	249.679	274.573	299.446	324.295+	349.120	373.918	398.688	423.426	448.133	472.805-	497.441
5°00'	25.000	49.997	74.989	99.975-	124.950	149.914	174.864	199.797	224.711	249.604	274.473	299.316	324.131	348.914	373.665+	398.381	423.059	447.697	472.292	496.844
5°30'	25.000	49.996	74.987	99.969	124.940	149.896	174.836	199.755-	224.651	249.521	274.362	299.173	323.948	348.687	373.386	398.042	422.653	447.215+	471.727	496.185
6°00'	24.999	49.995+	74.985-	99.963	124.929	149.877	174.804	199.708	224.584	249.430	274.242	299.016	323.749	348.439	373.081	397.672	422.209	446.689	471.109	495.465+
6°30'	24.999	49.995-	74.982	99.957	124.916	149.855+	174.770	199.657	224.512	249.331	274.110	298.845+	323.533	348.169	372.749	397.270	421.728	446.119	470.439	494.685+
7°00'	24.999	49.994	74.979	99.950	124.903	149.832	174.734	199.603	224.434	249.225-	273.969	298.662	323.300	347.878	372.391	396.837	421.209	445.504	469.717	493.845-
7°30'	24.999	49.993	74.976	99.943	124.889	149.807	174.694	199.544	224.351	249.110	273.816	298.464	323.049	347.565+	372.008	396.372	420.653	444.845+	468.944	492.945-
8°00'	24.999	49.992	74.973	99.935+	124.873	149.781	174.652	199.481	224.262	248.988	273.654	298.254	322.782	347.232	371.599	395.877	420.060	444.143	468.120	491.986
8°30'	24.999	49.991	74.969	99.927	124.857	149.753	174.608	199.415-	224.167	248.858	273.481	298.030	322.498	346.878	371.164	395.350	419.430	443.797	467.245+	490.969
9°00'	24.999	49.990	74.965+	99.918	124.840	149.723	174.560	199.344	224.066	248.720	273.298	297.793	322.197	346.503	370.704	394.794	418.764	442.608	466.321	489.894
9°30'	24.999	49.989	74.961	99.908	124.821	149.691	174.510	199.269	223.960	248.575-	273.105+	297.543	321.879	346.108	370.219	394.206	418.062	441.777	465.346	488.761
10°00'	24.998	49.987	74.957	99.899	124.802	149.658	174.457	199.190	223.848	248.422	272.902	297.279	321.545+	345.691	369.709	393.589	417.323	440.904	464.323	487.573

D. C.	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000
0°30'	50.000	100.000	150.000	199.999	249.999	299.998	349.996	399.995-	449.992	499.989	549.986	599.982	649.977	699.971	749.964	799.957	849.948	899.938	949.927	999.915-
1°00'	50.000	100.000	149.999	199.997	249.995-	299.991	349.985+	399.978	449.969	499.958	549.944	599.927	649.907	699.884	749.857	799.827	849.792	899.753	949.710	999.662
1°30'	50.000	99.999	149.997	199.994	249.988	299.979	349.967	399.951	449.931	499.905-	549.873-	599.836	649.791	699.739	749.679	799.610	849.532	899.445-	949.347	999.239
2°00'	50.000	99.999	149.995+	199.989	249.979	299.963	349.942	399.913	449.877	499.831	549.775-	599.708	649.635-	699.536	749.429	799.307	849.169	899.013	948.840	998.647
2°30'	50.000	99.998	149.993	199.983	249.967	299.943	349.909	399.865-	449.807	499.736	549.648	599.543	649.419	699.275-	749.108	798.917	848.702	898.459	948.188	997.886
3°00'	50.000	99.997	149.990	199.976	249.952	299.918	349.869	399.805+	449.722	499.619	549.493	599.342	649.164	698.956	748.716	798.441	848.131	897.781	947.391	996.957
3°30'	49.999	99.996	149.986	199.967	249.935+	299.888	349.822	399.735-	449.622	499.482	549.310	599.105-	648.862	698.579	748.252	797.879	847.456	896.981	946.450	995.860
4°00'	49.999	99.995-	149.982	199.957	249.915+	299.854	349.768	399.654	449.507	499.323	549.100	598.831	648.514	698.144	747.718	797.231	846.679	896.058	945.365+	994.595
4°30'	49.999	99.993	149.977	199.945+	249.893	299.815-	349.706	399.562	449.376	499.144	548.861	598.521	648.120	697.652	747.112	796.496	845.798	895.013	944.137	993.163
5°00'	49.999	99.992	149.971	199.932	249.868	299.772	349.637	399.459	449.229	498.943	548.593	598.174	647.679	697.102	746.436	795.676	844.815-	893.847	942.765-	991.564
5°30'	49.999	99.990	149.965+	199.918	249.840	299.724	349.561	399.345+	449.068	498.721	548.298	597.791	647.193	696.494	745.690	794.770	843.729	892.558	941.251	989.799
6°00'	49.998	99.988	149.959	199.903	249.810	299.671	349.478	399.221	448.891	498.479	547.975+	597.372	646.660	695.830	744.872	793.779	842.541	891.149	939.594	987.868
6°30'	49.998	99.986	149.952	199.888	249.777	299.614	349.387	399.086	448.698	498.215-	547.624	596.917	646.081	695.107	743.984	792.702	841.250	889.618	937.796	985.773
7°00'	49.998	99.983	149.944	199.867	249.741	299.552	349.289	398.940	448.491	497.930	547.246	596.425+	645.457	694.328	743.027	791.541	839.858	887.968	935.857	983.513
7°30'	49.998	99.981	149.936	199.848	249.703	299.486	349.184	398.783	448.267	497.624	546.839	595.898	644.787	693.491	741.999	790.295-	838.365+	886.197	933.777	981.091
8°00'	49.997	99.978	149.927	199.827	249.662	299.416	349.072	398.615+	448.029	497.298	546.404	595.334	644.071	692.598	740.901	788.964	836.771	884.307	931.557	978.506
8°30'	49.997	99.976	149.917	199.804	249.618	299.340	348.953	398.437	447.776	496.950	545.942	594.735-	643.309	691.648	739.734	787.549	835.077	882.299	929.199	975.759
9°00'	49.997	99.973	149.907	199.781	249.572	299.260	348.826	398.248	447.507	496.581	545.452	594.099	642.502	690.642	738.498	786.051	833.282	880.172	926.702	972.852
9°30'	49.996	99.969	149.897	199.756	249.523	299.176	348.692	398.048	447.223	496.192	544.935-	593.428	641.650	689.579	737.192	784.469	831.388	877.928	924.068	969.786
10°00'	49.996	99.966	149.886	199.729	249.472	299.087	348.551	397.838	446.923	495.782	544.389	592.721	640.752	688.459	735.818	782.804	829.395+	875.567	921.297	966.562

D. C.	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000
0°30'	33.333	66.667	100.000	133.334	166.668	200.002	233.336	266.671	300.006	333.342	366.678	400.014	433.352	466.689	500.028	533.367	566.707	600.048	633.390	666.733
1°00'	33.333	66.667	100.001	133.335+	166.671	200.007	233.345-	266.684	300.024	333.367	366.711	400.057	433.406	466.758	500.112	553.470	566.830	600.194	633.561	666.933
1°30'	33.333	66.667	100.002	133.338	166.676	200.016	233.359	266.705-	300.055-	333.408	366.766	400.129	433.498	466.872	500.253	533.640	567.035-	600.437	633.847	667.266
2°00'	33.333	66.668	100.004	133.342	166.683	200.029	233.379	266.735-	300.097	333.466	366.844	400.230	433.626	467.032	500.450	533.879	567.321	600.777	634.248	667.734
2°30'	33.334	66.668	100.006	133.347	166.693	200.045-	233.405-	266.773	300.152	333.541	366.944	400.360	433.791	467.238	500.703	534.187	567.691	601.216	634.764	668.336
3°00'	33.334	66.669	100.008	133.352	166.704	200.065-	233.436	266.820	300.218	333.633	367.066	400.518	433.992	467.490	501.013	534.564	568.144	601.754	635.398	669.076
3°30'	33.334	66.670	100.011	133.359	166.718	200.088	233.473	266.875+	300.297	333.741	367.210	400.706	434.231	467.789	501.381	535.011	568.680	602.392	636.149	669.954
4°00'	33.334	66.671	100.014	133.367	166.733	200.115	233.516	266.939	300.389	333.867	367.377	400.923	434.508	468.135-	501.807	535.528	569.302	603.131	637.020	670.972
4°30'	33.334	66.672	100.018	133.376	166.751	200.146	233.565-	267.012	300.492	334.009	367.567	401.169	434.822	468.527	502.291	536.117	570.010	603.973	638.013	672.133
5°00'	33.334	66.673	100.022	133.387	166.771	200.180	233.619	267.093	300.608	334.168	367.779	401.446	435.173	468.968	502.834	536.778	570.804	604.919	639.129	673.439
5°30'	33.334	66.675-	100.027	133.398	166.793	200.218	233.679	267.183	300.736	334.345-	368.014	401.752	435.563	469.456	503.436	537.511	571.687	605.971	640.371	674.893
6°00'	33.335-	66.676	100.032	133.410	166.817	200.259	233.745+	267.282	300.877	334.538	368.272	402.088	435.992	469.993	504.099	538.319	572.660	607.131	641.741	676.499
6°30'	33.335-	66.678	100.038	133.423	166.843	200.304	233.817	267.389	301.030	334.749	368.554	402.454	436.460	470.580	504.824	539.202	573.724	608.401	643.242	678.260
7°00'	33.335-	66.680	100.044	133.438	166.871	200.353	233.894	267.505+	301.196	334.977	368.858	402.851	436.967	471.216	505.610	540.161	574.882	609.783	644.878	680.181
7°30'	33.335+	66.682	100.051	133.453	166.901	200.405+	233.978	267.630	301.375-	335.223	369.187	403.280	437.514	471.903	506.460	541.199	576.134	611.280	646.653	682.267
8°00'	33.335+	66.684	100.058	133.470	166.933	200.461	234.067	267.764	301.566	335.486	369.539	403.739	438.101	472.641	507.374	542.316	577.484	612.896	648.569	684.522
8°30'	33.336	66.686	100.065-	133.487	166.968	200.521	234.162	267.907	301.770	335.767	369.915-	404.231	438.730	473.432	508.354	543.515-	578.934	614.633	650.631	686.952
9°00'	33.336	66.688	100.073	133.506	167.004	200.585-	234.264	268.058	301.987	336.066	370.316	404.754	439.401	474.276	509.400	544.796	580.486	616.494	652.844	689.563
9°30'	33.336	66.691	100.081	133.526	167.043	200.652	234.371	268.219	302.217	336.384	370.741	405.310	440.113	475.174	510.515+	546.163	582.144	618.484	655.214	692.364
10°00'	33.337	66.693	100.090	133.547	167.084	200.723	234.484	268.389	302.460	336.719	371.191	405.899	440.869	476.127	511.700	547.617	583.909	620.607	657.745+	695.359

D. C.	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000
0°30'	16.667	33.333	50.000	66.667	83.334	100.002	116.669	133.337	150.006	166.674	183.343	200.013	216.683	233.354	250.025+	266.698	283.370	300.044	316.719	333.394
1°00'	16.667	33.334	50.001	66.669	83.337	100.007	116.677	133.349	150.022	166.697	183.374	200.052	216.733	233.416	250.102	266.790	283.482	300.176	316.874	333.575+
1°30'	16.667	33.334	50.002	66.671	83.342	100.015-	116.690	133.368	150.050	166.735-	183.424	200.118	216.816	233.520	250.230	266.946	283.668	300.397	317.134	333.878
2°00'	16.667	33.334	50.003	66.674	83.348	100.026	116.708	133.395+	150.088	166.788	183.494	200.209	216.933	233.666	250.409	267.163	283.929	300.707	317.498	334.303
2°30'	16.667	33.335-	50.005+	66.679	83.357	100.041	116.731	133.430	150.138	166.856	183.585+	200.327	217.082	233.853	250.639	267.443	284.265-	301.106	317.968	334.852
3°00'	16.667	33.336	50.007	66.684	83.367	100.059	116.760	133.473	150.199	166.939	183.696	200.471	217.266	234.082	250.922	267.786	284.676	301.595+	318.544	335.525-
3°30'	16.667	33.336	50.010	66.690	83.380	100.080	116.794	133.523	150.270	167.038	183.828	200.642	217.483	234.354	251.256	268.192	285.165-	302.176	319.228	336.324
4°00'	16.667	33.337	50.013	66.698	83.394	100.105-	116.833	133.581	150.353	167.152	183.979	200.839	217.735-	234.668	251.643	268.663	285.731	302.849	320.021	337.251
4°30'	16.667	33.338	50.017	66.706	83.410	100.132	116.877	133.647	150.448	167.281	184.152	201.064	218.020	235.026	252.084	269.199	286.375-	303.615+	320.925+	338.308
5°00'	16.667	33.339	50.020	66.715+	83.428	100.163	116.926	133.721	150.553	167.426	184.345-	201.315-	218.340	235.427	252.578	269.801	287.099	304.477	321.942	339.498
5°30'	16.668	33.341	50.025-	66.725+	83.448	100.198	116.981	133.803	150.670	167.586	184.559	201.593	218.695+	235.871	253.127	270.469	287.903	305.436	323.074	340.824
6°00'	16.668	33.342	50.029	66.736	83.470	100.236	117.041	133.893	150.798	167.762	184.794	201.899	219.086	236.360	253.731	271.205-	288.790	306.493	324.324	342.290
6°30'	16.668	33.344	50.034	66.749	83.493	100.277	117.106	133.991	150.937	167.954	185.050	202.233	219.512	236.895-	254.391	272.010	289.760	307.652	325.694	343.898
7°00'	16.668	33.345+	50.040	66.762	83.519	100.321	117.177	134.096	151.088	168.162	185.327	202.595-	219.974	237.475-	255.108	272.885-	290.816	308.913	327.188	345.653
7°30'	16.668	33.347	50.046	66.776	83.546	100.369	117.253	134.210	151.250	168.386	185.626	202.985-	220.472	238.101	255.883	273.832	291.960	310.281	328.810	347.560
8°00'	16.669	33.349	50.052	66.791	83.576	100.420	117.334	134.332	151.424	168.625+	185.947	203.404	221.008	238.774	256.717	274.852	293.193	311.758	330.562	349.624
8°30'	16.669	33.351	50.059	66.807	83.607	100.474	117.421	134.461	151.610	168.881	186.290	203.852	221.581	239.496	257.612	275.946	294.518	313.346	332.450	351.850
9°00'	16.669	33.353	50.066	66.824	83.641	100.532	117.513	134.599	151.808	169.154	186.655+	204.329	222.193	240.266	258.568	277.118	295.938	315.050	334.477	354.244
9°30'	16.669	33.355+	50.074	66.842	83.676	100.593	117.610	134.746	152.017	169.443	187.043	204.836	222.843	241.086	259.587	278.368	297.455-	316.873	336.650	356.814
10°00'	16.670	33.358	50.082	66.861	83.713	100.657	117.713	134.900	152.239	169.749	187.453	205.374	223.534	241.957	260.670	279.699	299.072	318.820	338.973	359.566

°C.	RADIUS	°C.	RADIUS	°C.	RADIUS	°C.	RADIUS	°C.	RADIUS	°C.	RADIUS	°C.	RADIUS	°C.	RADIUS
		0°40'	8,594.367	1°20'	4,297.183	2°00'	2,864.789	2°40'	2,148.592	3°20'	1,718.873	4°00'	1,432.394	4°40'	1,227.767	5°20'	1,074.296
0°01'	343,774.677	41'	8,384.748	21'	4,244.132	01'	2,841.113	41'	2,135.246	21'	1,710.321	01'	1,426.451	41'	1,223.397	21'	1,070.949
02'	171,887.339	42'	8,185.111	22'	4,192.374	02'	2,817.825+	42'	2,122.066	22'	1,701.855-	02'	1,420.557	42'	1,219.059	22'	1,067.623
03'	114,591.559	43'	7,994.760	23'	4,141.864	03'	2,794.916	43'	2,109.047	23'	1,693.471	03'	1,414.711	43'	1,214.752	23'	1,064.318
04'	85,943.669	44'	7,813.061	24'	4,092.556	04'	2,772.376	44'	2,096.187	24'	1,685.170	04'	1,408.913	44'	1,210.474	24'	1,061.033
0°05'	68,754.935+	0°45'	7,639.437	1°25'	4,044.408	2°05'	2,750.197	2°45'	2,083.483	3°25'	1,676.950	4°05'	1,403.162	4°45'	1,206.227	5°25'	1,057.768
06'	57,295.780	46'	7,473.363	26'	3,997.380	06'	2,728.370	46'	2,070.932	26'	1,668.809	06'	1,397.458	46'	1,202.009	26'	1,054.524
07'	49,110.668	47'	7,314.355-	27'	3,951.433	07'	2,706.887	47'	2,058.531	27'	1,660.747	07'	1,391.800	47'	1,197.821	27'	1,051.299
08'	42,971.835-	48'	7,161.972	28'	3,906.530	08'	2,685.740	48'	2,046.278	28'	1,652.763	08'	1,386.188	48'	1,193.662	28'	1,048.094
09'	38,197.186	49'	7,015.810	29'	3,862.637	09'	2,664.920	49'	2,034.170	29'	1,644.855-	09'	1,380.621	49'	1,189.532	29'	1,044.908
0°10'	34,377.468	0°50'	6,875.494	1°30'	3,819.719	2°10'	2,644.421	2°50'	2,022.204	3°30'	1,637.022	4°10'	1,375.099	4°50'	1,185.430	5°30'	1,041.742
11'	31,252.243	51'	6,740.680	31'	3,777.744	11'	2,624.234	51'	2,010.378	31'	1,629.264	11'	1,369.620	51'	1,181.356	31'	1,038.594
12'	28,647.890	52'	6,611.051	32'	3,736.681	12'	2,604.354	52'	1,998.690	32'	1,621.579	12'	1,364.185+	52'	1,177.311	32'	1,035.466
13'	26,444.206	53'	6,486.315-	33'	3,696.502	13'	2,584.772	53'	1,987.137	33'	1,613.966	13'	1,358.793	53'	1,173.292	33'	1,032.356
14'	24,555.334	54'	6,366.198	34'	3,657.177	14'	2,565.483	54'	1,975.717	34'	1,606.424	14'	1,353.444	54'	1,169.301	34'	1,029.266
0°15'	22,918.312	0°55'	6,250.449	1°35'	3,618.681	2°15'	2,546.479	2°55'	1,964.427	3°35'	1,598.952	4°15'	1,348.136	4°55'	1,165.338	5°35'	1,026.193
16'	21,485.917	56'	6,138.834	36'	3,580.986	16'	2,527.755-	56'	1,953.265+	36'	1,591.549	16'	1,342.870	56'	1,161.401	36'	1,023.139
17'	20,222.040	57'	6,031.135-	37'	3,544.069	17'	2,509.304	57'	1,942.230	37'	1,584.215+	17'	1,337.645-	57'	1,157.490	37'	1,020.103
18'	19,098.593	58'	5,927.150	38'	3,507.905-	18'	2,491.121	58'	1,931.318	38'	1,576.948	18'	1,332.460	58'	1,153.606	38'	1,017.085-
19'	18,093.404	59'	5,826.689	39'	3,472.471	19'	2,473.199	59'	1,920.529	39'	1,569.747	19'	1,327.315+	59'	1,149.748	39'	1,014.085-
0°20'	17,188.734	1°00'	5,729.578	1°40'	3,437.747	2°20'	2,455.533	3°00'	1,909.859	3°40'	1,562.612	4°20'	1,322.210	5°00'	1,145.916	5°40'	1,011.102
21'	16,370.223	01'	5,635.650	41'	3,403.710	21'	2,438.118	01'	1,899.308	41'	1,555.542	21'	1,317.144	01'	1,142.109	41'	1,008.137
22'	15,626.122	02'	5,544.753	42'	3,370.340	22'	2,420.948	02'	1,888.872	42'	1,548.535-	22'	1,312.117	02'	1,138.327	42'	1,005.189
23'	14,946.725+	03'	5,456.741	43'	3,337.618	23'	2,404.019	03'	1,878.550	43'	1,541.590	23'	1,307.128	03'	1,134.570	43'	1,002.259
24'	14,323.945-	04'	5,371.479	44'	3,305.526	24'	2,387.324	04'	1,868.341	44'	1,534.708	24'	1,302.177	04'	1,130.838	44'	999.345-
0°25'	13,750.987	1°05'	5,288.841	1°45'	3,274.045-	2°25'	2,370.860	3°05'	1,858.241	3°45'	1,527.887	4°25'	1,297.263	5°05'	1,127.130	5°45'	996.448
26'	13,222.103	06'	5,208.707	46'	3,243.157	26'	2,354.621	06'	1,848.251	46'	1,521.127	26'	1,292.386	06'	1,123.447	46'	993,568
27'	12,732.395+	07'	5,130.965+	47'	3,212.847	27'	2,338.603	07'	1,838.367	47'	1,514.426	27'	1,287.546	07'	1,119.787	47'	990.705+
28'	12,277.667	08'	5,055.510	48'	3,183.099	28'	2,322.802	08'	1,828.589	48'	1,507.784	28'	1,282.741	08'	1,116.152	48'	987.858
29'	11,854.299	09'	4,982.242	49'	3,153.896	29'	2,307.213	09'	1,818.914	49'	1,501.199	29'	1,277.973	09'	1,112.539	49'	985.028
0°30'	11,459.156	1°10'	4,911.067	1°50'	3,125.224	2°30'	2,291.831	3°10'	1,809.340	3°50'	1,494.673	4°30'	1,273.240	5°10'	1,108.951	5°50'	982.213
31'	11,089.506	11'	4,841.897	51'	3,097.069	31'	2,276.653	11'	1,799.867	51'	1,488.202	31'	1,268.541	11'	1,105.384	51'	979.415+
32'	10,742.959	12'	4,774.648	52'	3,069.417	32'	2,261.676	12'	1,790.493	52'	1,481.787	32'	1,263.877	12'	1,101.842	52'	976.633
33'	10,417.414	13'	4,709.242	53'	3,042.254	33'	2,246.893	13'	1,781.216	53'	1,475.428	33'	1,259.248	13'	1,098.322	53'	973.866
34'	10,111.020	14'	4,645.604	54'	3,015.567	34'	2,232.303	14'	1,772.034	54'	1,469.123	34'	1,254.652	14'	1,094.824	54'	971.115-
0°35'	9,822.134	1°15'	4,583.662	1°55'	2,989.345+	2°35'	2,217.901	3°15'	1,762.947	3°55'	1,462.871	4°35'	1,250.090	5°15'	1,091.348	5°55'	968.379
36'	9,549.297	16'	4,523.351	56'	2,963.575-	36'	2,203.684	16'	1,753.952	56'	1,456.673	36'	1,245.560	16'	1,087.895-	56'	965.659
37'	9,291.207	17'	4,464.606	57'	2,938.245+	37'	2,189.648	17'	1,745.049	57'	1,450.526	37'	1,241.064	17'	1,084.463	57'	962.954
38'	9,046.702	18'	4,407.368	58'	2,913.345-	38'	2,175.789	18'	1,736.236	58'	1,444.431	38'	1,236.600	18'	1,081.052	58'	960.264
39'	8,814.735+	19'	4,351.578	59'	2,888.863	39'	2,162.105-	19'	1,727.511	59'	1,438.388	39'	1,232.167	19'	1,077.664	59'	957.590
0°40'	8,594.367	1°20'	4,297.183	2°00'	2,864.789	2°40'	2,148.592	3°20'	1,718.873	4°00'	1,432.394	4°40'	1,227.767	5°20'	1,074.296	6°00'	954.930

°C.	RADIUS	°C.	RADIUS	°C.	RADIUS	°C.	RADIUS	°C.	RADIUS	°C.	RADIUS	°C.	RADIUS	°C.	RADIUS
6°00'	954.930	6°40'	859.437	7°20	781.306	8°00'	716.197	8°40'	661.105+	9°20'	613.883	10°00'	572.958	10°40'	537.148	11°20'	505.551
01'	952.284	41'	857.293	21'	779.534	01'	714.708	41'	659.836	21'	612.789	01'	572.004	41'	536.310	21'	504.809
02'	949.654	42'	855.161	22'	777.771	02'	713.225+	42'	658.572	22'	611.699	02'	571.054	42'	535.475-	22'	504.068
03'	947.038	43'	853.039	23'	776.015+	03'	711.749	43'	657.313	23'	610.612	03'	570,107	43'	534.642	23'	503.330
04'	944.436	44'	850.927	24'	774.267	04'	710.278	44'	656.059	24'	609.530	04'	569.163	44	533.812	24	502.595-
6°05'	941.848	6°45'	848.826	7°25'	772.527	8°05'	708.814	8°45'	654.309	9°25	608.451	10°05'	568.223	10°45	532.984	11°25'	501.861
06'	939.275+	46'	846.736	26'	770.795+	06'	707.355+	46'	653.564	26'	607.376	06'	567.285-	46	532.159	26'	501.129
07'	936.716	47'	844.655+	27'	769.071	07'	705.903	47'	652.324	27	606.305-	07'	566.350	47'	531.336	27'	500.400
08'	934.170	48'	842.585-	28'	767.354	08'	704.456	48'	651.088	28'	605.237	08'	565.419	48'	530.516	28'	499.672
09'	931.639	49'	840.525-	29'	765.645+	09'	703.016	49'	649.858	29'	604.173	09'	564.490	49	529.699	29	498.947
6°10'	929.121	6°50'	838.475-	7°30'	763.944	8°10'	701.581	8°50'	648.631	9°30'	603.113	10°10'	563.565+	10°50'	528.884	11°30'	498.224
11'	926.616	51'	836.435-	31'	762.250	11'	700.152	51'	647.410	31'	602.057	11'	562.643	51	528.072	31'	497.503
12'	924.125-	52'	834.405-	32'	760.563	12'	698.729	52'	646.193	32'	601.005-	12'	561.723	52'	527.262	32'	496.784
13'	921.648	53'	832.384	33'	758.884	13'	697.312	53'	644.981	33'	599.956	13'	560.807	53'	526.454	33'	496.067
14'	919.184	54'	830.374	34'	757.213	14'	695.900	54'	643.773	34'	598.911	14'	559.894	54	525.649	34'	495.353
6°15'	916.732	6°55'	828.373	7°35'	755.549	8°15'	694.494	8°55'	642.569	9°35	597.869	10°15'	558.983	10°55'	524.847	11°35'	494.640
16'	914.294	56'	826.381	36'	753.892	16'	693.094	56'	641.371	36'	596.831	16'	558.076	56'	524.047	36'	493.929
17'	911.869	57'	824.400	37'	752.242	17'	691.700	57'	640.176	37'	595.797	17'	557.171	57'	523.249	37'	493.220
18'	909.457	58'	822.427	38'	750.600	18'	690.311	58'	638.986	38'	594.766	18'	556.270	58'	522.454	38'	492.514
19'	907.057	59'	820.465-	39'	748.964	19'	688.927	59	637.801	39'	593.739	19'	555.371	59'	521.661	39'	491.809
6°20'	904.670	7°00'	818.511	7°40'	747.336	8°20'	687.549	9°00'	636.620	9°40'	592.715-	10°20'	554.475+	11°00'	520.871	11°40'	491.107
21'	902.296	01'	816.567	41'	745.715+	21'	686.177	01'	635.443	41'	591.695-	21'	553.582	01	520.083	41'	490.406
22'	899.934	02'	814.632	42'	744.101	22'	684.810	02'	634.271	42'	590.678	22'	552.692	02'	519.297	42'	489.708
23'	897.584	03'	812.706	43'	742.494	23'	683.449	03'	633.103	43'	589.665-	23'	551.805+	03'	518.514	43'	489.011
24'	895.247	04'	810.789	44'	740.894	24'	682.093	04'	631.939	44'	588.655+	24'	550.921	04	517.733	44	488.316
6°25'	892.921	7°05'	808.882	7°45'	739.300	8°25'	680.742	9°05'	630.779	9°45'	587.649	10°25'	550.039	11°05'	516.954	11°45'	487.624
26'	890.608	06'	806.983	46'	737.714	26'	679.397	06'	629.624	46'	586.646	26'	549.161	06'	516.178	46'	486.933
27'	888.307	07'	805.093	47'	736.134	27'	678.057	07'	628.473	47'	585.647	27'	548.285-	07'	515.404	47'	486.244
28'	886.017	08'	803.212	48'	734.561	28'	676.722	08'	627.326	48'	584.651	28'	547.412	08'	514.633	48'	485.557
29'	883.740	09'	801.340	49'	732.995+	29'	675.392	09'	626.183	49'	583.658	29'	546.542	09'	513.863	49	484.873
6°30'	881.474	7°10'	799.476	7°50'	731.435+	8°30'	674.068	9°10'	625.045-	9°50'	582.669	10°30'	545.674	11°10	513.097	11°50'	484.190
31'	879.219	11'	797.621	51'	729.883	31'	672.749	11'	623.910	51'	581.683	31'	544.809	11'	512.332	51'	483.509
32'	876.976	12'	795.775-	52'	728.336	32'	671.435-	12'	622.780	52'	580.700	32'	543.947	12'	511.569	52'	482.830
33'	876.745-	13'	793.937	53'	726.796	33'	670.126	13'	621.654	53'	579.721	33'	543.088	13'	510.809	53'	482.152
34'	872.525-	14'	792.108	54'	725.263	34'	668.822	14'	620.532	54'	578.745+	34'	542.231	14'	510.051	54'	481.477
6°35'	870.316	7°15'	790.287	7°55'	723.736	8°35'	667.524	9°15'	619.414	9°55'	577.773	10°35'	541.377	11°15	509.296	11°55'	480.804
36'	868.118	16'	788.474	56'	722.216	36'	666.230	16'	618.300	56'	576.803	36'	540.526	16'	508.542	56'	480.132
37'	865.931	17'	786.670	57'	720.702	37'	664.941	17'	617.190	57'	575.837	37'	539.678	17'	507.791	57'	479.463
38'	863.755+	18'	784.874	58'	719.194	38'	663.658	18'	616.084	58'	574.874	38'	538.832	18'	507.042	58'	478.795-
39'	861.591	19'	783.086	59'	717.692	39'	662.379	19'	614.982	59'	573.914	39'	537.989	19'	506.296	59'	478.129
6°40'	859.437	7°20'	781.306	8°00'	716.197	8°40'	661.105+	9°20'	613.883	10°00	572.958	10°40'	537.148	11°20'	505.551	12°00'	477.465-

°C.	RADIUS	°C.	RADIUS	°C.	RADIUS	°C.	RADIUS	°C.	RADIUS	°C.	RADIUS	°C.	RADIUS	°C.	RADIUS
12°00'	477.465-	13°20'	429.718	14°40'	390.653	16°00'	358.099	17°20'	330.553	18°40'	306.942	20°00'	286.479	27°00	212.207	34°00'	168.517
02'	476.142	22'	428.647	42'	389.767	02'	357.354	22'	329.918	42'	306.395-	10'	284.111	10'	210.905-	10'	167.695-
04'	474.827	24'	427.580	44'	388.885+	04'	356.613	24'	329.286	44'	305.849	20'	281.783	20	209.619	20'	166.881
06'	473.519	26'	426.519	46'	388.008	06'	355.874	26'	328.656	46'	305.306	30'	279.492	30'	208.348	30'	166.075-
08'	472.218	28'	425.464	48'	387.134	08'	355.139	28'	328.029	48'	304.765-	40'	277.238	40'	207.093	40'	165.276
												50'	275.020	50	205.853	50'	164.485+
12°10'	470.924	13°30'	424.413	14°50'	386.264	16°10'	354.407	17°30'	327.404	18°50'	304.225+						
12'	469.638	32'	423.368	52'	385.398	12'	353.678	32'	326.782	52'	303.688	21°00'	272.837	28°00'	204.628	35°00'	163.702
14'	468.358	34'	422.328	54'	384.535+	14'	352.951	34'	326.162	54'	303.152	10'	270.689	10'	203.417	10'	162.926
16'	467.085+	36'	421.292	56'	383.677	16'	352.228	36'	325.544	56'	302.619	20'	268.574	20'	202.220	20'	162.158
18'	465.819	38'	420.263	58'	382.823	18'	351.508	38	324.929	58'	302.087	30'	266.492	30'	201.038	30'	161.397
												40'	264.442	40'	199.869	40'	160.642
12°20''	464.560	13°40'	419.237	15°00'	381.972	16°20'	350.790	17°40'	324.316	19°00	301.557	50'	262.423	50'	198.714	50'	159.895+
22'	463.308	42'	418.217	02'	381.125-	22'	350.076	42'	323.705-	02'	301.029						
24'	462.063	44'	417.202	04'	380.282	24'	349.365-	44'	323.097	04'	300.502	22°00'	260.435+	29°00'	197.572	36°00'	159.155-
26'	460.824	46'	416.192	06'	379.442	26'	348.656	46'	322.490	06'	299.978	10'	258.477	10'	196.443	10'	158.422
28'	459.592	48'	415.187	08'	378.606	28'	347.950	48'	321.886	08'	299.455+	20'	256.548	20'	195.327	20'	157.695-
												30'	254.648	30'	194.223	30'	156.975-
12°30'	458.366	13°50'	414.186	15°10'	377.774	16°30'	347.247	17°50'	321.285-	19°10'	298.935-	40'	252.775+	40	193.132	40'	156.261
32'	457.147	52'	413.191	12'	376.946	32'	346.547	52'	320.685+	12'	298.416	50'	250.930	50'	192.053	50'	155.554
34'	455.935-	54'	412.200	14'	376.121	34'	345.850	54'	320.088	14'	297.898						
36'	454.728	56'	411.214	16'	375.300	36'	345.155+	56'	319.493	16'	297.383	23°00'	249.112	30°00'	190.986	37°00'	154.853
38'	453.529	58'	410.232	18'	374.482	38'	344.464	58'	318.900	18'	296.869	10'	247.320	10'	189.931	10'	154.159
												20'	245.553	20'	188.887	20'	153.471
12°40'	452.335+	14°00'	409.256	15°20'	373.668	16°40'	343.775-	18°00'	318.310	19°20'	296.357	30'	243.812	30'	187.855+	30'	152.789
42'	451.148	02'	408.283	22'	372.858	42'	343.089	02'	317.722	22'	295.847	40'	242.095-	40'	186.834	40'	152.113
44'	449.967	04'	407.316	24'	372.051	44'	342.405+	04'	317.135+	24'	295.339	50'	240.402	50	185.824	50'	151.443
46'	448.792	06'	406.353	26'	371.247	46'	341.724	06'	316.551	26'	294.832						
48'	447.623	08'	405.395-	28'	370.447	48'	341.046	08'	315.969	28'	294.328	24°00'	238.732	31°00'	184.825+	38°00'	150.778
												10'	237.086	10'	183.837	10'	150.120
12°50'	446.461	14°10'	404.441	15°30'	369.650	16°50'	340.371	18°10'	315.390	19°30'	293.825-	20'	235.462	20'	182.859	20'	149.467
52'	445.304	12'	403.491	32'	368.857	52'	339.698	12'	314.812	32'	293.323	30'	233.860	30'	181.891	30'	148.820
54'	444.153	14'	402.546	34'	268.067	54'	339.028	14'	314.236	34'	292.823	40'	232.280	40'	180.934	40'	148.179
56'	443.009	16'	401.606	36'	367.281	56'	338.361	16'	313.663	36'	292.325+	50'	230.721	50'	179.987	50'	147.543
58'	441.870	18'	400.670	38'	366.497	58'	337.696	18'	313.092	38'	291.829						
												25°00'	229.183	32°00'	179.049	39°00'	146.912
13°00	440.737	14°20'	399.738	15°40'	365.718	17°00'	337.034	18°20'	312.522	19°40'	291.334	10'	227.665+	10'	178.122	10'	146.287
02'	439.610	22'	398.811	42'	364.941	02'	336.374	22'	311.955+	42'	290.842	20'	226.168	20'	177.203	20'	145.667
04'	438.488	24'	397.887	44'	364.168	04'	335.717	24'	311.390	44'	290.350	30'	224.689	30'	176.295-	30'	145.053
06'	437.372	26'	396.968	46'	363.398	06'	335.063	26'	310.827	46'	289.861	40'	223.230	40'	175.395+	40'	144.443
08'	436.262	28'	396.054	48'	362.632	08'	334.411	28'	310.266	48'	289.372	50'	221.790	50'	174.505-	50'	143.839
13°10'	435.158	14°30'	395.143	15°50'	361.868	17°10'	333.762	18°30'	309.707	19°50'	288.886	26°00'	220.368	33°00'	173.624	40°00'	143.239
12'	434.059	32'	394.237	52'	361.107	12'	333.115-	32'	309.150	52'	288.402	10'	218.965-	10'	172.751	10'	142.645+
14'	432.966	34'	393.335-	54'	360.351	14'	332.471	34'	308.595-	54'	287.918	20'	217.579	20'	171.887	20'	142.056
16'	431.878	36'	392.437	56'	359.597	16'	331.829	36'	308.042	56'	287.437	30'	216.210	30'	171.032	30'	141.471
18'	430.795+	38'	391.543	58'	358.846	18'	331.189	38'	307.491	58'	286.957	40'	214.859	40'	170.185+	40'	140.891
13°20'	429.718	14°40'	390.653	16°00'	358.099	17°20'	330.553	18°40'	306.942	20°00'	286.479	50'	213.525-	50'	169.347	50'	140.316
												27°00'	212.207	34°00	168.517	41°00'	139.746

°C.	RADIUS	°C.	RADIUS	°C.	RADIUS	°C.	RADIUS	°C.	RADIUS	°C.	RADIUS	°C.	RADIUS	°C.	RADIUS
41°00'	139.746	48°00'	119.366	55°00'	104.174	62°00'	92.412	69°00'	83.037	76°00'	75.389	83°00'	69.031	90°00'	63.662
10'	139.180	10'	118.953	10'	103.859	10'	92.165-	10'	82.837	10'	75.224	10'	68.893	10'	63.544
20'	138.619	20'	118.543	20'	103.547	20'	91.918	20'	82.638	20'	75.060	20'	68.755-	20'	63.427
30'	138.062	30'	118.136	30'	103.236	30'	91.673	30'	82.440	30'	74.896	30'	68.618	30'	63.310
40'	137.510	40'	117.731	40'	102.927	40'	91.429	40'	82.243	40'	74.734	40'	68.481	40'	63.194
50'	136.962	50'	117.329	50'	102.619	50'	91.187	50'	82.046	50'	74.572	50'	68.345-	50'	63.078
42°00'	136.419	49°00'	116.930	56°00'	102.314	63°00'	90.946	70°00'	81.851	77°00'	74.410	84°00'	68.209	91°00'	62.962
10'	135.879	10'	116.534	10'	102.010	10'	90.706	10'	81.657	10'	74.249	10'	68.074	10'	62.847
20'	135.344	20'	116.140	20'	101.708	20'	90.467	20'	81.463	20'	74.089	20'	67.940	20'	62.733
30'	134.814	30'	115.749	30'	101.408	30'	90.230	30'	81.271	30'	73.930	30'	67.806	30'	62.618
40'	134.287	40'	115.361	40'	101.110	40'	89.993	40'	81.079	40'	73.771	40'	67.672	40'	62.504
50'	133.764	50'	114.975-	50'	100.814	50'	89.758	50'	80.888	50'	73.613	50'	67.539	50'	62.391
43°00'	133.246	50°00'	114.592	57°00'	100.519	64°00'	89.525-	71°00'	80.698	78°00'	73.456	85°00'	67.407	92°00'	62.278
10'	132.732	10'	114.211	10'	100.226	10'	89.292	10'	80.509	10'	73.300	10'	67.275-	10'	62.165+
20'	132.221	20'	113.833	20'	99.934	20'	89.061	20'	80.321	20'	73.144	20'	67.143	20'	62.053
30'	131.714	30'	113.457	30'	99.645-	30'	88.831	30'	80.134	30'	72.988	30'	67.013	30'	61.941
40'	131.212	40'	113.084	40'	99.357	40'	88.602	40'	79.948	40'	72.834	40'	66.882	40'	61.830
50'	130.713	50'	112.713	50'	99.071	50'	88.374	50'	79.762	50'	72.680	50'	66.752	50'	61.719
44°00'	130.218	51°00'	112.345-	58°00'	98.786	65°00'	88.147	72°00'	79.577	79°00'	72.526	86°00'	66.623	93°00'	61.608
10'	129.726	10'	111.979	10'	98.503	10'	87.922	10'	79.394	10'	72.374	10'	66.494	10'	61.498
20'	129.238	20'	111.615+	20'	98.221	20'	87.698	20'	79.211	20'	72.222	20'	66.366	20'	61.388
30'	128.755-	30'	111.254	30'	97.942	30'	87.474	30'	79.029	30'	72.070	30'	66.238	30'	61.279
40'	128.274	40'	110.895+	40'	97.663	40'	87.252	40'	78.847	40'	71.919	40'	66.111	40'	61.170
50'	127.797	50'	110.538	50'	97.387	50'	87.032	50'	78.667	50'	71.769	50'	65.984	50'	61.061
45°00'	127.324	52°00'	110.184	59°00'	97.111	66°00'	86.812	73°00'	78.487	80°00'	71.620	87°00'	65.857	94°00'	60.095+
10'	126.854	10'	109.832	10'	96.838	10'	86.593	10'	78.309	10'	71.471	10'	65.731	10'	60.845
20'	126.388	20'	109.482	20'	96.566	20'	86.376	20'	78.131	20'	71.323	20'	65.606	20'	60.738
30'	125.925-	30'	109.135-	30'	96.295+	30'	86.159	30'	77.953	30'	71.175-	30'	65.481	30'	60.630
40'	125.465+	40'	108.789	40'	96.026	40'	85.944	40'	77.777	40'	71.028	40'	65.356	40'	60.524
50'	125.009	50'	108.446	50'	95.759	50'	85.729	50'	77.602	50'	70.881	50'	65.232	50'	60.417
46°00'	124.556	53°00'	108.105+	60°00'	95.493	67°00'	85.516	74°00'	77.427	81°00'	70.736	88°00'	65.109	95°00'	60.311
10'	124.106	10'	107.766	10'	95.228	10'	85.304	10'	77.253	10'	70.590	10'	64.986	10'	60.206
20'	123.660	20'	107.430	20'	94.965+	20'	85.093	20'	77.080	20'	70.446	20'	64.863	20'	60.100
30'	123.217	30'	107.095-	30'	94.704	30'	84.883	30'	76.907	30'	70.302	30'	64.741	30'	59.996
40'	122.777	40'	106.762	40'	94.444	40'	84.674	40'	76.735+	40'	70.158	40'	64.619	40'	59.891
50'	122.340	50'	106.432	50'	94.185-	50'	84.466	50'	76.565-	50'	70.015+	50'	64.498	50'	59.787
47°00'	121.906	54°00'	106.103	61°00'	93.928	68°00'	84.258	75°00'	76.394	82°00'	69.873	89°00'	64.377	96°00'	59.683
10'	121.475+	10'	105.777	10'	93.672	10'	84.052	10'	76.225	10'	69.731	10'	64.257		
20'	121.047	20'	105.452	20'	93.417	20'	83.847	20'	76.056	20'	69.590	20'	64.137		
30'	120.623	30'	105.130	30'	93.164	30'	83.643	30'	75.888	30'	69.449	30'	64.018		
40'	120.201	40'	104.809	40'	92.912	40'	83.440	40'	75.721	40'	69.309	40'	63.899		
50'	119.782	50'	104.491	50'	92.662	50'	83.238	50'	75.555-	50'	69.170	50'	63.780		
48°00'	119.366	55°00'	104.174	62°00'	92.412	69°00'	83.037	76°00'	75.389	83°00'	69.031	90°00'	63.662		